Vancouver School Board

STRATEGIC ENERGY MANAGEMENT PLAN

Update 2021-2022

Pathways to 2030 — and beyond

with the support of:

BC Hydro Power smart

A VSB SUSTAINABILITY RESOURCE

Summary

Energy management has been a part of VSB operations and capital planning for many years. This has historically been focused to reduce energy costs. More recently, and more urgently, has been the requirement for energy management to address climate change by reducing carbon emissions from facilities.

This document presents a Strategic Energy Management Plan (SEMP) as a guidance document for conservation activities. It identifies current (one-year time frame funded projects), short term (rolling three-year) and long term (to 2030 and beyond) opportunities for conservation and climate action. In the current year projects are identified to achieve over 300,000 kWh or energy savings.

For the long-term perspective – to 2030 and beyond this plan is driven around two key goals. These are:

> Goal 1: Achieve reductions in building related carbon emissions of 50% from 2010 levels by 2030-2035.
>
> Goal 2: Prepare new and current building systems for a future of low-carbon, and no-carbon heating systems.

This energy strategy has six key action areas. These are:

Action 1:	Lighting upgrades
Action 2:	Heating Plant Upgrades
Action 3:	Building System Upgrades and Replacement
Action 4:	Continuous Optimization of Buildings
Action 5:	Low-Carbon Implementation into the Seismic Mitigation Program
Action 6:	Electric Vehicle Opportunities

Three scenarios of level-of-effort implementation were created – these bound the range of activity from low (doing best efforts with current levels of capital funding and policies), a middle level of resources and high effort scenario (where all projects include substantial incremental resources for carbon reduction).

The implementation timeline of these scenarios are based on i) the capital plan priorities as a guide for seismic renewal and ii) the current suite of minor capital programs accessible to the District. Recent project results are used as a guide to the levels of carbon reductions possible. Each of the scenarios results in a different level of carbon emission reduction – ranging from a 22% reduction (lowest effort scenario) to a 42% reduction (highest effort scenario) by 2035.

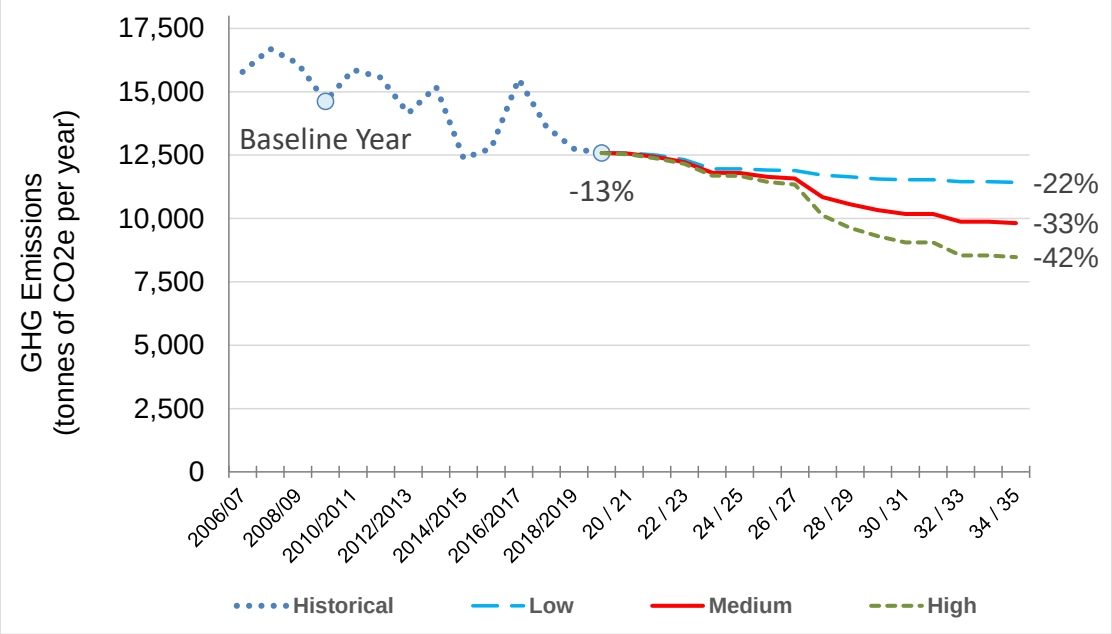
Capital investment requirements for these scenarios range from $26 to $98 million over the period 2020 to 2035. At present, funding has been identified for only a small fraction of this requirement. Further reductions beyond 2035 have been identified which require similar levels of capital investment.

Key summary results are shown in Table S-1 and a trajectory of carbon emission reductions is provided in Figure S-1.

Table S-1: Impact of Energy/Carbon Plan Implementation at 2035

		Level of Effort and Resources		
Item	**Units**	**Low**	**Medium**	**High**
Baseline Building Carbon Emissions	tonnes CO2/yr	15,160	15,160	15,160
Carbon reduction (tonnes)	tonnes / yr	(3,200)	(4,800)	(6,100)
…change from baseline	(%)	-22%	-33%	-42%
Electricity Consumption change	kWh/yr	2,500,000	4,300,000	5,600,000
Net Change to total Utility, Offset, CoV Carbon Levy Costs	$ / yr	1,130,000	500,000	200,000
Capital Requirements 2020 – 2035	$	26,000,000	51,000,000	98,000,000

Figure S-1: VSB Building -Related Carbon Emissions by Scenario



In January 2019, Vancouver Council declared a climate emergency as a call to scale up Vancouver's efforts to cut carbon pollution. In April 2019, Council approved the Climate Emergency Response – a high level policy statement, which established six key areas of activity (referred to as "Big Moves") to guide the City's efforts in response to the climate emergency. Subsequent policy work has evolved into a "Climate Emergency Action Plan" (CEAP) which developed 'pathways' for implementing the policy of Big Moves 2 through 5.

The Climate Emergency policy identified 53 “accelerated actions” that the city could deploy to initiate change swiftly. A scan of these indicates that 17 lend themselves to the VSB being a participant or contributor, 12 are future possibilities for VSB involvement, and 24 are not generally applicable to the VSB as they are city operations or exclusively under municipal authority. The actions where the VSB could be a participant are generally consistent with the actions in the VSB Environmental Sustainability Plan.

Management Concurrence

Ron Macdonald
Director of Facilities
Energy Manager

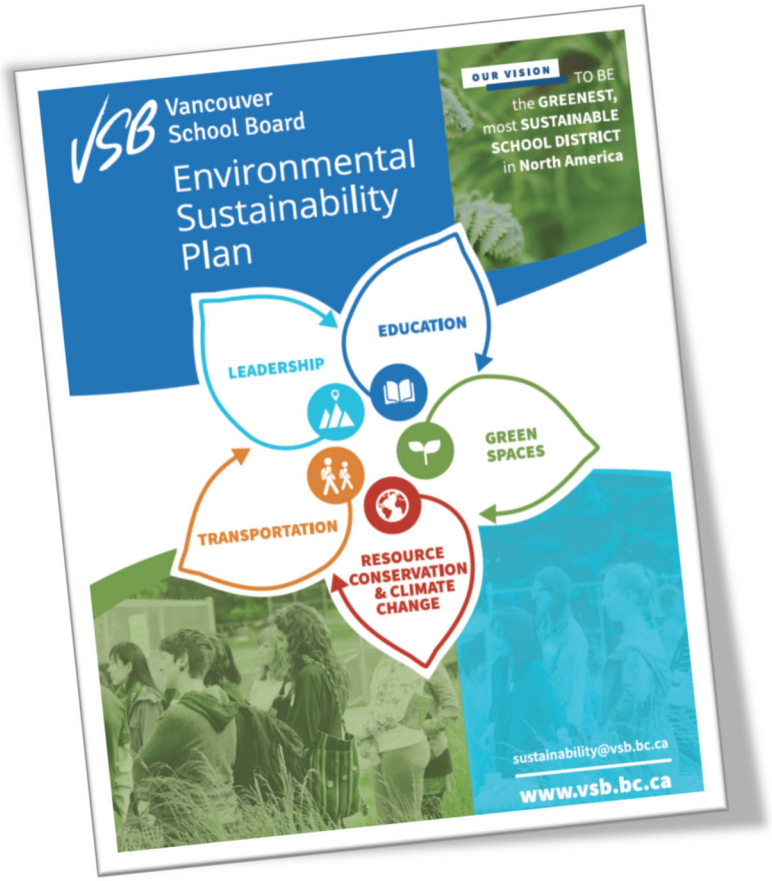
David Green
Secretary Treasurer

Acknowledgements

The District is engaged with BC Hydro in their Energy Manager Program for the K-12 educational sector. The Energy Manager program provides financial and technical support to energy managers across many sectors. A component of this partnership is the development of this Strategic Energy Management Plan (SEMP). This plan was developed by Vancouver School Board staff with the support of the Energy Manager Program of BC Hydro.

Context

The VSB's Environmental Sustainability Plan was adopted by the Board of Trustees in 2018, and captured input from all levels of the VSB community. The Plan includes five theme areas and three implementation principles that guide sustainability and energy management work in the VSB. This SEMP supports the goal to reduce energy consumption and greenhouse gas emissions through Action 9: Maintain an active energy management program.



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Acronyms and Abbreviations

BEPI	"Building Energy Performance Index". A measure of the energy used by a building - on a "per floor area" basis (typically kWh/ft^2). BEPI is a common energy metric used in building operations and can include all energy use – heating, lighting, systems, and plug loads, or can be analyzed for one component, or one fuel only.
CNCP	Carbon Neutral Capital Program. A grant fund available to school districts. It currently dispenses about $5 million per year across the province for projects that reduce carbon emissions and improve energy efficiency.
C.Op.	"Continuous Optimization" - a program of BC Hydro to improve the energy efficiency of existing buildings through a review of operating issues. Commonly thought of as a 'tune-up' for buildings.
ekWh	equivalent kWh. The energy use converted into kWh for a common presentation as in a BEPI value. One GJ of natural gas consumption converts to 278 ekWh.
DDC	Direct Digital Control: A computerized control system for a building.
GJ	"Giga Joule" – literally, a billion joules. A measure of energy – most often used with natural gas or other heating fuels. A GJ is about the energy contained in a tank of gas for a passenger car.
kW	kilowatt (thousands of Watts) a measure of how fast energy is consumed (not how much). A kilowatt is *approximately* the power used by a counter-top kettle or a microwave oven
kWh	kilo watt-hour. "thousands" of watt-hours. A measure of energy consumed - but not how fast it is consumed.
LEED	Leadership in Energy and Environmental Design. A rating system of the design and construction of buildings.
NCP	New Construction Program. A BC Hydro incentive program to encourage the construction of high efficiency buildings.
PSO	Public Sector Organization
PSPX	Power Smart Express. A program of BC Hydro whereby incentives can be provided swiftly for direct change outs of equipment for more efficient equipment.
Power Smart	A program of BC Hydro to encourage energy conservation through education and incentives.
SEMP	Strategic Energy Management Plan. This document.
SMP	Seismic Mitigation Program
VBE	Vancouver Board of Education, Also School District #39, or VSB.
VSB	Vancouver School Board, Also School District #39 or VBE
W	Watt (W) - a measure of the rate of energy consumption.

1 Introduction

The Vancouver School Board (VSB) is the second largest school district in British Columbia, encompassing over 118 sites, approximately 48,000 students, and nearly 8,000 full-time and part-time employees. The District is committed to continuously improving the energy efficiency and environmental performance of its operations and activities – and has had an active energy management program for over a decade.

This document presents an energy strategy for the district that includes:

- Identification of current year conservation projects,
- a rolling three-year project list, and
- a pathway showing the opportunities to achieve longer term reductions in carbon emissions over the next 10-15 years.

Annual updates to this document will increment these annual and rolling lists and track progress of the District's carbon footprint reduction measures.

Purpose

The objectives of the strategic energy management plan (SEMP) are to:

- Define a multi-year strategy for managing energy consumption, managing costs, and reducing carbon emissions through an active energy management program, and
- Define and maintain a rolling action plan list to identify and execute actions over many years.

Energy Management Objectives

Energy management activities aim to achieve a number of objectives. These include to:

- Minimize annual energy, carbon tax, and carbon offset purchase costs,
- Reduce greenhouse gas (GHG) emissions,
- Optimize up-front capital costs for new and retrofit facilities, and
- Minimize long term maintenance and operational staff burden and cost of (energy related) operations, and to
- Prepare VSB facilities for anticipated needs and impacts of climate change.

The objectives do not always align easily, and energy management activities must strive to achieve the best balance of benefits while remaining flexible in order to adapt to future opportunities and conditions.

2 Context for Energy Management

Energy management and climate change action are supported by several policy and plan commitments.

Policy directives that support energy management include:

- VSB2021 Strategic Plan: The Board's 2021 strategic plan supports energy management – primarily through Goal #4 with actions to "manage school district resources effectively," and to "implement a long-term financial model"

- VSB Environmental Sustainability Plan: The VSB Environmental Sustainability Plan (approved May 2018) includes actions to reduce resource consumption, water use, and waste generation, and to reduce carbon emissions and prepare for the impact of climate change.

- Carbon Neutral Public Sector: The Provincial government has directed all public sector organizations (PSOs) to be "carbon neutral" through the purchase of carbon offsets from the Ministry of the Environment.

- CleanBC Plan: The BC Government's Clean BC plan specifies that PSOs will reduce the carbon emissions from their buildings by 50% by the year 2030 (from their 2010 level).

- City of Vancouver Climate Emergency Action Plan: The City of Vancouver adopted a Climate Emergency Plan in Dec 2020. The plan document specifies requirements for reducing the carbon footprint of buildings. The next step in the plan implementation is the adoption of by-laws and regulations to require the movement to low-carbon heating systems.

Business drivers that support energy management include:

- Leverage Capital Spending: The seismic mitigation program (SMP) is a once-in-a-generation opportunity for the District to leverage capital funding provided for seismic safety to achieve reductions in carbon emissions, energy use, and to prepare the district for the changing climate of the future.

- Instructional Comfort: A co-benefit of energy management is that properly tuned and functioning heating and lighting systems provide higher functioning buildings, which leads to improved occupant comfort, reduced occupant complaints, and a better learning environment.

- Cost Management: Management of energy results in better management of energy utility costs.

- Infrastructure and asset management: Energy management is aligned with good infrastructure management practices.

3 Organizational Profile

Facility Profile

The VSB operates a large "fleet" of schools as well as associated support facilities. A summary of key annual operating statistics is shown in Table 1.

Table 1: Operating Statistics for the VSB

	Item	2020 / 2021	Units
People	Secondary Students	21,000	number
	Elementary Students	27,200	number
	Other learning program students	900	number
	Employees (FT and PT)	~ 8,000	number
Facilities	Secondary Schools (number)	18	number
	Secondary Schools (area)	337,000	square meters
	Elementary Schools (number)	90	number
	Elementary Schools (area)	394,000	square meters
	Other facilities and sites	7	number
	Other facilities and sites	35,650	number
Budget (2020/2021)	Total District operating	~ 523	millions of $ per year
	Operations and Maintenance	~ 63	millions of $ per year
	AFG Capital Allocation	~ 11	millions of $ per year
Energy Use (2020/21)	Electricity Consumption	26,137,000	kWh per year
	Electricity expenditure	$ 3,112,000	$ per year
	Natural Gas Consumption	287,000	GJ per year
	Natural Gas spending	$ 3,085,000	$ per year

Past Energy Management

The District has implemented many energy management activities since at least 2005. In 2009 the District joined BC Hydro's energy Manager program and began a program of upgrading lighting systems through-out the District. In 2013, the District established a five-year energy management strategy. For 2018 and 2019 the energy management program has centered around annual project planning and one-year target setting.

A summary of the projects implemented from 2013 onward is shown in Table 2 and detailed in Appendix C. Combined, these projects result in savings (or avoided increases) of $750,000 annually.

Table 2: Recent Electricity Conservation Projects

Year	**Electricity** Conservation Projects		**Natural Gas** Conservation Projects	
	Project Locations (number)	Total Electricity Savings kWh	Project Locations (number)	Total Natural Gas Savings GJ
2013 / 14	14	683,000	2	1,400
2014 / 15	8	495,000	8	1,470
2015 / 16	7	536,000	15	0
2016 / 17	18	662,000	2	4,500
2017 / 18	13	1,302,000	2	9,500
2018 / 19	7	587,000	1	1,175
2019 / 20	14	709,000	4	6.880
2020 / 21	6	455,000	5	3,300
Totals	**87**	**5,484,000**	**39**	**21,350**
Approximate annual savings		**$ 550,000**		**$ 210,000**

Notes:

1) The number of site locations may include the same site repeated in different years as some facilities were upgraded in phases.

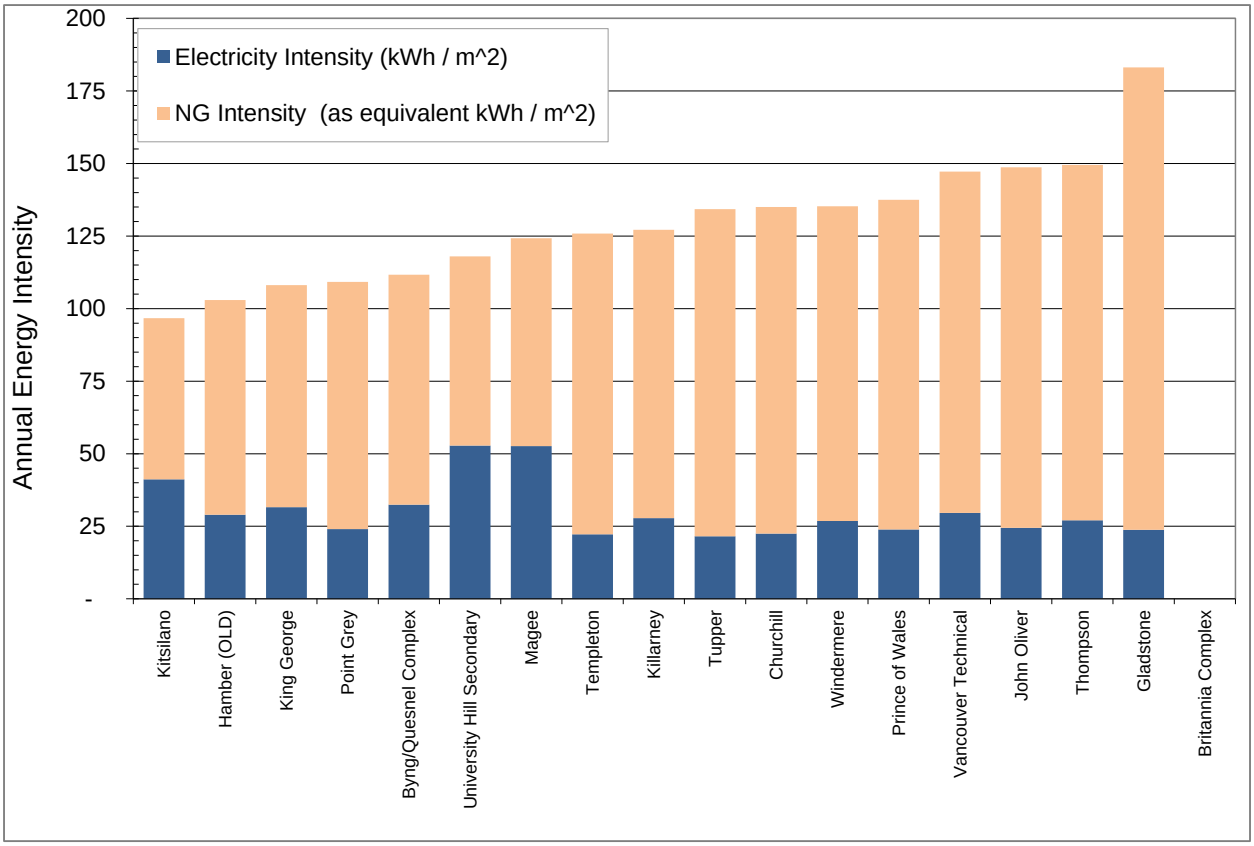
Current Building Performance

A commonly used measure of building energy efficiency is *the "energy use intensity*". This metric is the "*energy use per square meter of floor area*". This metric is an industry standard for comparing energy performance. Frequently it is called an "energy use index" (EUI) or a "Building Energy Performance Index" (BEPI). The units used here are "equivalent kilowatt-hours" (ekWh). Electricity is measured in kilowatt-hours, and natural gas in giga-joules (GJ). The GJ of natural gas can be converted to equivalent kWh to show the total energy use.

Secondary Schools

The District operates 18 secondary schools, averaging about 19,000 m^2 each (about 200,000 square feet). Total energy use intensities (BEPI values) range from ~90 to 175 ekWh / m^2 (see Figure 1) - not including the Britannia sites, which are part of a larger community center complex.

Figure 1: Energy Consumption Intensity: Secondary Schools (2020/2021)



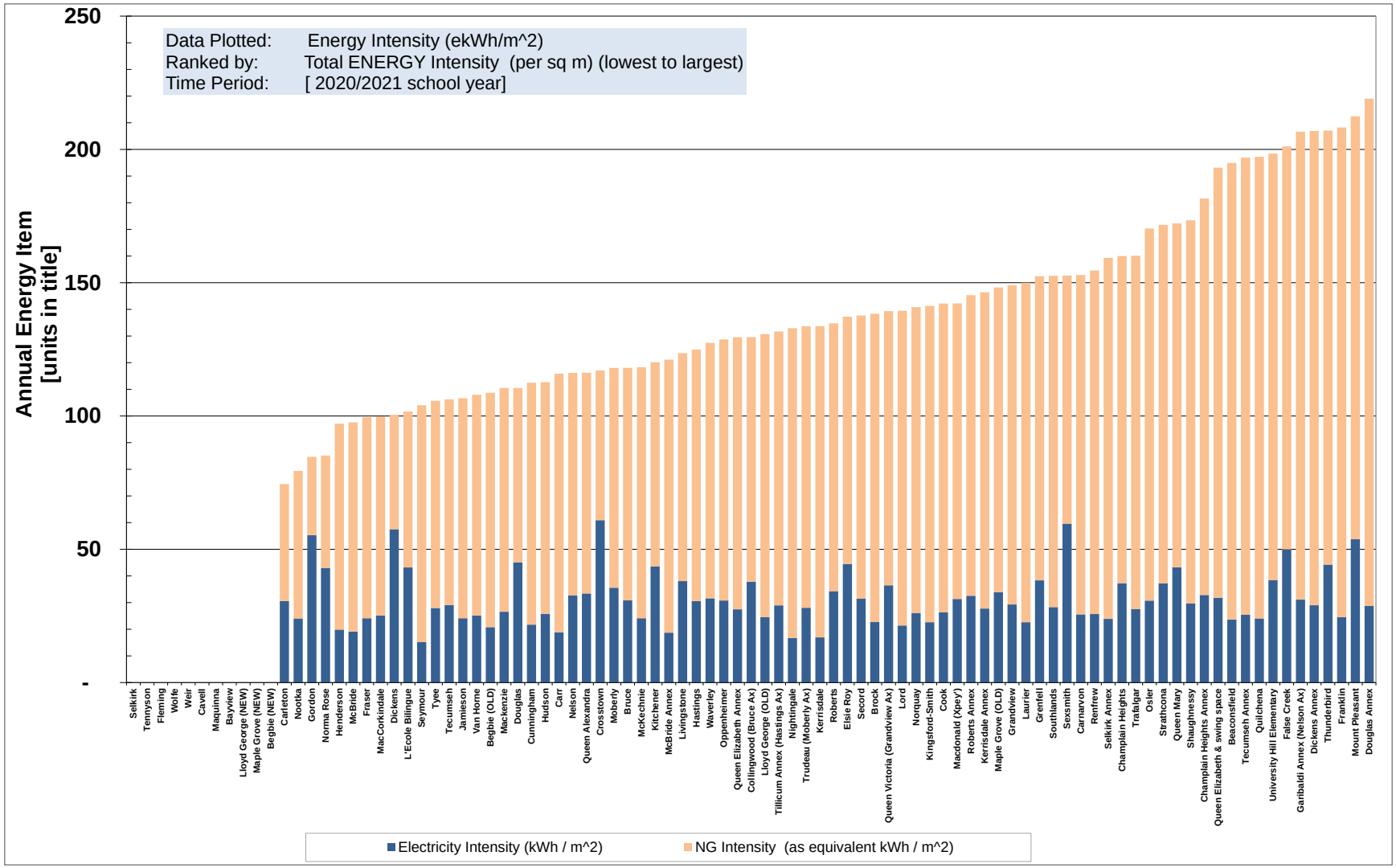
Notes:

1) Natural Gas Consumption for Britannia Secondary & Elementary complex is not known reliably due to insufficient sub-metering within the Britannia School and Community center complex.

Elementary Schools

The District operates 88 elementary schools and annexes, averaging about 4,300 square meters (about 46,000 square feet). BEPI values range from 75 to 220 kWh/m^2 (Figure 2). Note that this is for the total of both electricity and natural gas.

Figure 2: Energy Consumption Intensity: Elementary Schools (2020/2021)



Notes: 1) Sites showing zero energy consumption are currently undergoing seismic upgrading and a complete year of data is not available

4 Going Forward: To 2030 and beyond

Energy management has historically been about managing costs – both capital spending on equipment, and operating utility and maintenance costs. The current environment for energy management strategies requires continued action on costs, but also must include carbon emissions reduction, create facilities to be resilient to energy system disruption, and be capable of addressing future climate change impacts. This section describes a '*pathway'* for energy management over the next decade at the VSB.

Getting to 2030

Scientific research of the impact of climate change, Federal and Provincial legislation, and the general public's understanding of the impacts of global climate change are driving all sectors of society to eventually function at low-carbon or zero-carbon emission levels. The current benchmarks defined to achieve a reasonably stabilized climate indicate that:

- over the next decade, global carbon emissions must decrease by about 50%, and
- further reductions to near zero are required by about 2050.

The VSB energy and carbon strategy acknowledges that the District has a mandate (one of societal expectations, and one of Provincial policy) to make reductions in our 'carbon footprint'. To meet the 2030 obligations, Goal #1 is proposed:

> *Goal 1: Reduce building-related carbon emissions by 50% from 2010 levels by 2030.*

Beyond 2030

Moving from 2030 onward to 2050 requires that all installations and upgrades be suitable for a zero-carbon future beyond 2030. The 50% carbon reduction goal is only "Part 1" of a longer-term reduction in emissions that is required. As buildings are long-life infrastructure, the systems we put in place today must be made ready for the future. To meet this obligation Goal #2 is proposed.

> *Goal 2: Prepare new and existing buildings for a future of low-carbon and zero-carbon heating systems targeting to be a net-zero carbon district by 2050.*

Achieving both these goals requires maximizing reductions in the short-term (2-10 year) while also maintaining options open to achieve further reductions in the period after 2030. Actions taken today must avoid 'locking in' carbon-intensive technologies and systems – but also maintain the flexibility to adapt to evolving technologies available to the District in the future.

Finding a Pathway to Low-Carbon & No-Carbon Buildings

There are several 'pathways' to a low carbon future – depending on the specific site, the systems in place, the age of the facility, and whether the site is on the seismic risk mitigation program.

Traditional heating systems use natural gas boilers to make either steam or 'high temperature' water (typically ~85 deg C) which is circulated through the building to provide heating (see Figure 3). The steam or hot water is the 'heat delivery' system. The endpoint is the radiators and heating coils transfer the heat into the working spaces.

A low-carbon or no- carbon heating system typically uses a heat pump to create 'low-temperature' water (~50 deg C) for heating (see Figure 4). The systems within a building to deliver the heat must be designed for the temperature of the water.

Meeting the dual objectives of 1) making substantial short-term reductions in carbon emission, and 2) preparing the District for a long term evolution to very-low-, or no-carbon emissions requires a bundle of different energy management actions. These include:

Lighting Upgrades

'LED' lighting technologies have displaced older fluorescent, halogen, HPS, and other lighting technologies for all areas of schools. There are opportunities remaining for the District to implement lighting upgrades.

Building Optimization

Building optimization or 'recommissioning' actions review a buildings set-up and operations. These 'tune-ups identify efficiencies in automation programs and controls.

Steam System Conversions

Transitioning an existing building from steam heating to low/no carbon heating requires:

- Step 1: Convert to a water system by simultaneously: (1a) replacing the steam boilers with water boilers or a heat pump, (1b) replacing the heat distribution piping with hydronic (water) piping and (1c) replacing the heat delivery components.

- Step 2: Addition of a heat pump to reduce the use of fossil fuels.

Step 2 could be achieved at the time of implementation of Step 1 if sufficient capital were available or could be deferred.

High Temperature Water System Conversions

Transitioning an existing building from high temperature water heating to low/no carbon heating requires:

- Step 1: Convert from old inefficient boilers to new boilers capable of operating at low temperature

- Step 2: Replace the heat delivery components (radiators and coils) to function with low temperature water

- Step 3: Retrofit the low temp water system for a heat pump

In converting an existing high temperature water system to low temperature operation, Steps 1 and 2 can be implemented together or separately, but both must be completed before Step 3.

Mechanical Upgrades

Many of the components of the existing buildings are suitable for replacement – air handlers, unit ventilators, pumps, and motors etc. This renewal activity has the potential to create more efficient and more comfortable learning environments.

Seismic Mitigation and New School Development

New schools – either through the seismic mitigation or expansion capital funding programs, are typically more efficient than older schools. As well, where possible, the capital funding may be able to support heat pumps. If not, the schools are designed to be 'heat pump ready' for future addition of heat pump technology.

Advancing and Emerging Technologies for Low-/No- Carbon Heating Systems

New technologies are appearing in the marketplace using refrigerants as the fluid to distribute heat within a building. The VSB is currently pilot-testing Variable Refrigerant Flow (VRF) technology, at several sites for the rooftop childcare centers. This technology is widely used in Europe and Japan but is more recent to the North American market. Other technologies exist or are emerging and are to be following and evaluated.

A summary of the types of sites relevant for each type of action is summarized in Table 3 – indicating the typical savings achievable, and an estimate of the number of sites that each action is applicable to.

Figure 3: Conventional Heating System Configuration

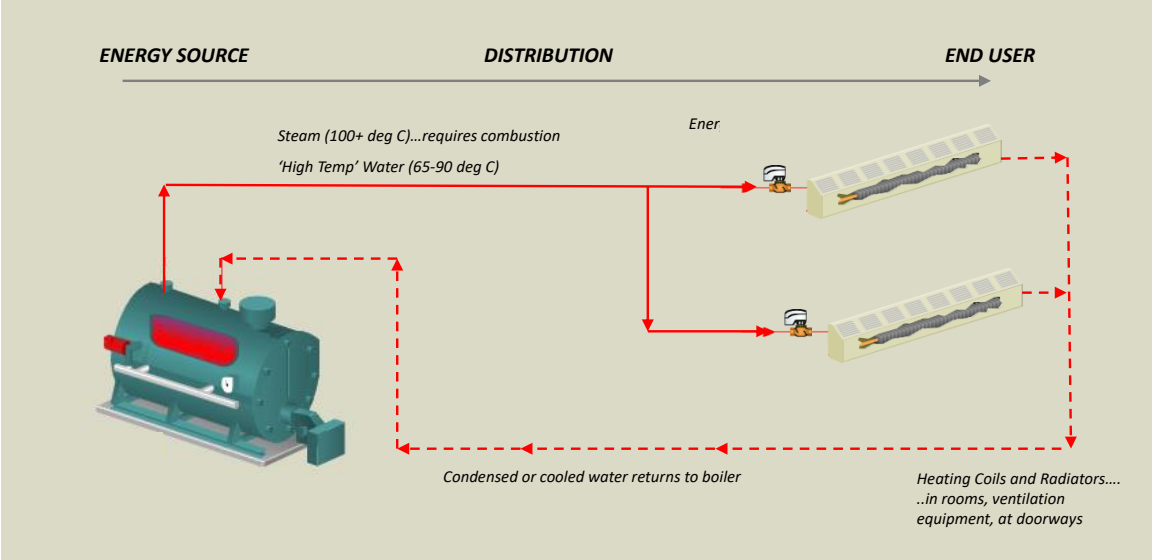


Figure 4: Common Low-Carbon Heating System Used in VSB Schools

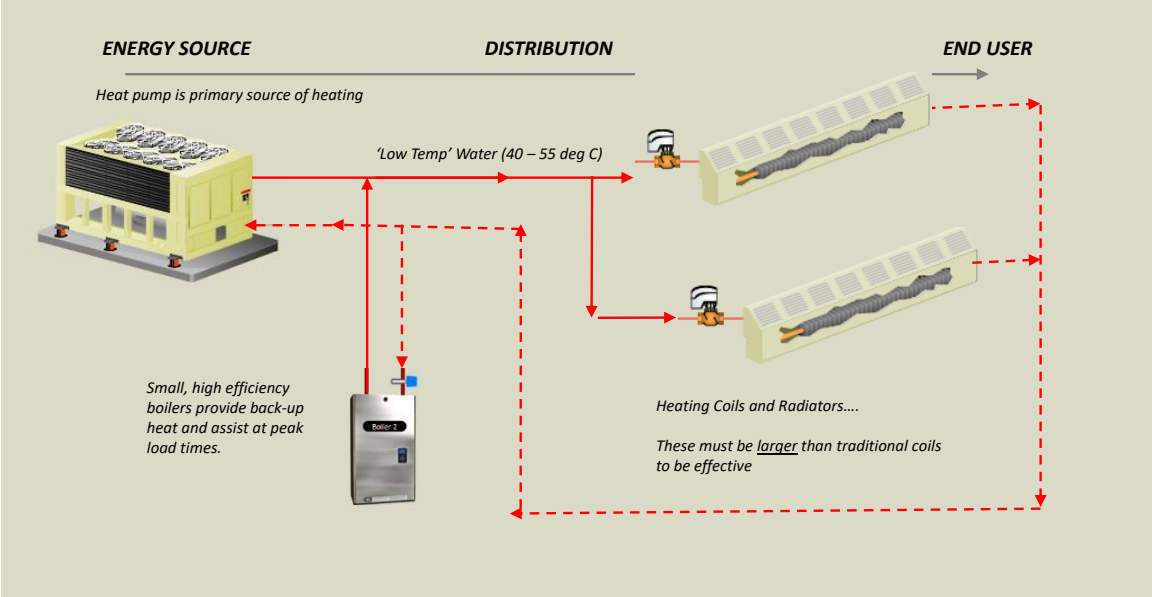


Table 3: Pathway Options to Reduce Carbon emissions

Item	Number of Potential sites	Activity	Carbon Savings (per site from baseline)	Cost
Lighting Upgrades	~10-20	Upgrade lighting to LED – this includes projects both within and outside the seismic mitigation program.	small	Depends on size of project ($50 k$ to $150 k$ is typical)
Building Optimization	~ 12	Optimize the building operations	5% - 15%	$25 k$ (elem) to $75 k$ (secondary)
Steam - to water conversions *Note: Projects identified are stand-alone activities. Does not include sites subject to the seismic mitigation program.*	4-5 (elem) 1-2 (sec)	Step 1: Replace steam heating system with hydronic system at low temperatures incl i) heat source, ii) distribution, iii) delivery components	~10%-25%?	$1.5 million (each elem) $5 - $10 million (each secondary).
		Step 2: Add heat pump to provide a low carbon heat source	40%	$500 k$ to $1.5 million depending on size.
Convert high temperature water system to low temp *(NB Steps 1 and 2 can be implemented together or separately, but both must be completed before Step 3)*	12-16	Step 1: Convert from existing high temperature boilers to new condensing boilers capable of operating at low temperature	30% - 50%	$350 k$ (elem) ~ $700 k$ (secondary)
		Step 2: Replace radiators and coils to work with low temperature water	5% - 15%	several $100 k$
		Step 3: Add heat pump to provide a low carbon heat source	Incremental 30%	~$750 k$
Mechanical Upgrades	20-50	Upgrade heat delivery systems (e.g., unit ventilators or air handlers) with new components Rework mechanical pumping and piping systems for greater efficiency	10% - 25%	~ $ 400k (elem) $ tbd secondary
Seismic Mitigation Project	~ up to 40	Project type 1: Seismic upgrade – may or may not include mechanical system upgrades	5% to 15%	Ranges from "included in project" to several $100 k$ (elem) additional funding.
		Project type 2: New site – with low temp water system – but no heat pump	30% - 50%	Typically zero (included with SMP project cost)
		Project type 3: New site – with low temp water system and current technology heat pump	60% - 80%	Elementary: $400 k$ if power supply is in place to $800+ k$ if power supply upgrades required.
New Technologies	?	Retrofit, or build new with heating and cooling technologies that are new to the market and not yet widespread in the BC market or yet deployed in the VSB.	?	?

Key Actions

This section categories the key opportunities going forward.

Action 1: Lighting upgrades

Over the 15 years the VSB has replaced many older lighting systems ("T12s" and old model "T8s") with newer "T8s" and more recently LED retrofits. The district still has facilities with older generation lighting systems. Replacing old lighting has the primary benefit of improving the classroom lighting quality.

Based on the number of projects implemented over the past decade, there are estimated to be about 2-3 years of lighting projects remaining. This action will:

- Change out T12 lighting systems for facilities that are not pending imminent seismic upgrading.
- Upgrade older T8 systems (more than 10 years old) to 'TLED" or "LED fixture" technology.
- Upgrade exterior lighting through the District.

Action 2: Heating Plant Upgrades

Most existing boilers within the district are considered "at or beyond" their manufacturer's specified service life based on age, and typical equipment lifetimes. [Note that all functioning boilers are properly maintained, regularly inspected, and meet BC Safety Authority requirements – regardless of age]. As most schools operate for ~40-60 hours / week, there is rarely a viable business case to replace a *functioning* older boiler for a newer one based on energy savings alone. However, replacements are made based on needs for facility renewal, reducing maintenance callouts, and modernization. As well heating plants are sometimes upgraded in seismic retrofits.

When boilers are replaced, this action will:

- ensure that all new boilers are the most efficient possible for the expected operating conditions,
- be suitable for future lower temperature operating conditions when updates are made to heat delivery systems, and
- be suitable for future retrofit into a heat-pump or other low carbon heating system.

Action 3: Building System Upgrades and Replacement

This action focuses on upgrading the energy delivery and ventilation systems to take advantage of low temperature heating water, and modern variable speed pumping systems. This could include replacing unit ventilators in classrooms with modern units, upgrading coils inside air handlers, and (most importantly), converting a steam-heating

facility to a water heated one. These upgrades carry substantial costs and so have to be implemented in larger 'pieces' than lighting projects or elementary heating plant replacements.

This action will:

- seek funding for upgrades to heat delivery systems, and
- prepare schools for future low carbon heat sources.

Action 4: Continuous Optimization and Improve Controls for Buildings

Beginning in 2018, the Energy Management Program began conducting building 'tune-ups' (sometimes called recommissioning). Suited to large facilities, optimization projects have been completed at University Hill and VanTech Secondary schools in capital year 2020, Magee in 2022 and will be implemented at Kitsilano in 2023.

This action will:

- Implement the C.Op. program in phases completing 1-3 sites annually.
- upgrade DDC and communications systems for all applicable (i.e. non-manually operated) facilities to be connected to the District-wide control network by 2035.

Action 5: Low-Carbon Implementation into the Seismic Mitigation Program

The seismic mitigation program has upgraded or replaced over 20 facilities within the district and the current capital plan defines an additional 20-25 facilities potentially requiring upgrades over the next decade. This program – a "once in a generation" opportunity – can be leveraged to improve energy efficiency, prepare for climate change impacts, and reduce carbon emissions.

This action will:

- encourage the inclusion of energy management considerations into PDR reports, and subsequent facility design.
- Develop energy specific guidance material for new school construction
- Contribute to design and construction standards
- Explore and Pilot Test evolving Technologies

Action 6: Electric Vehicle Opportunities

Electric vehicles are rapidly becoming commonplace in the transportation area and there are emerging opportunities for the VSB to advance electrification of its vehicle fleet - currently ~ 80 vehicles based at 2 sites (not counting numerous pieces of specialty equipment). Fleet electrification requires more than simply vehicle purchases as charging infrastructure and electrical capacity at sites may require upgrades. As well, different

work practices may or may not be amenable to electrification based on current market opportunities.

This action will:

- Participate with BC Hydro on a capacity assessment and an EV study for existing vehicle base-locations.
- Work with our vehicle suppliers to determine the costs and availability of suitable electric vehicles.
- Monitor evolving technologies for public and/or VSB charging infrastructure to evaluate suitable cost recovery models for the provision of charging infrastructure.

A detailed listing of all the projects identified for either execution or evaluation is contained in Appendix A.

5 Energy Plan Implementation

Project List

A summary of the identified projects for the current and next several years is shown in Table 4. A detailed listing of the identified and possible future opportunities is provided in Appendix A.

Projects completed at present are 2020/21 with the 2021/22 projects currently (Dec 2021) being implemented. These projects achieve incremental annual reductions of:

- 250,000 to 300,000 kWh electricity consumption
- 3,500 to 5,000 GJ of natural gas consumption
- ~200 to 250 tonnes of carbon emissions,
- $50,000 - $80,000 of incremental utility cost savings or avoided costs.

Table 4: VSB Energy Plan: Management: Three Year Opportunities from 2020/21

Year	Summary Description	Electricity Savings (kWh / yr)	Natural Gas Savings (GJ / year)	Carbon Reduction (tonnes CO2e / yr)	Utility Savings ($/year)
2021 (ending March 31) Projects completed	• Lighting projects at six sites • Heat plant replacements at two sites • Completion of heat plant upgrades / replacements at three sites through the SMP	450,000	4,800	250	$ 88,500
2022 Projects (underway)	• Lighting Projects at four sites • Heat plant replacements at one existing sites • Re-commissioning of one site • Heat plant replacement at one SMP site. • Heat pump installation at two SMP sites	610,000	2,000	175	$ 74,600
2023 Projects being assessed	• Lighting Projects at six sites • 1 heat plant replacement proposed • Re-commissioning of one site • One new SMP project • EV capacity study through BC Hydro	300,000	~5,000	245	$ 79,000
2024 Projects being planned.	• Lighting Projects (sites tbd) • Proposed 1 heat plant replacement • Re-commissioning of one site	230,000	~5,000	245	$ 79,000

Year	Summary Description	Electricity Savings (kWh / yr)	Natural Gas Savings (GJ / year)	Carbon Reduction (tonnes CO2e / yr)	Utility Savings ($/year)
2025 – 2030 Projects on the horizon	• Lighting opportunities decreasing. • 1 - 2 heating plant replacements annually. • Continued re-commissioning program. • Leverage seismic opportunities as available.	~50,000 – 100,000 annually	~3,000 – 6,000 annually	150 – 300 GJ annually	$ 40,000 - $80,000 annually

Notes:
1) All projects are dependent upon approval of budget. Only 2022 project year funds have been approved to-date.
2) Some projects that reduce carbon emissions, will also result in increases in electricity consumption.
3) Electricity savings shown here are for the specific conservation projects identified. Electrical savings achieved may exceed the incentivized amounts reported by BC Hydro due to specific incentive program requirements.

Carbon Reduction Scenarios

This energy strategy addresses the requirement to reduce carbon emissions and does not focus solely on the management of energy costs (the more traditional driver for energy management). This plan includes a longer-term perspective to identify the opportunities to achieve carbon reductions by District facilities.

The long-term planning tool for capital renewal is the annual VSB Capital Planning cycle. Each year the district submits a “five-year” requested forecast of capital needs for major capital funding and an annual forecast for minor capital programs. In practice – given the demands for capital funding on the Education Ministry, no school district is able to realize their full capital plan request list. Regardless, it is valid as a statement of capital funding priorities.

The major and minor capital activities the district plans for are:

- Major capital including the Seismic Mitigation Program (SMP) - potentially impacting 25 sites (over a decade or more), and several desired expansion projects.

- Minor capital programs including the Annual Facilities Grant (AFG), the School Enhancement Program (SEP), the Carbon Neutral Capital Program (CNCP), and the Playground Enhancement Program (PEP).

Capital funding is approved annually. General assumptions for the scenarios below are that future funding is in line with historical precedent.

Combining the currently approved and proposed capital planning project list, and some assumptions about internal project funding and results (see methodology in Appendix B),

three scenarios are developed for analysis. In each scenario, the current programs continue, however the resources available for carbon reduction vary. These are planning-level scenarios and are not developed to predict the full scope, timing, and details of each project in the capital plan. However, they do provide an opportunity to 'bound the problem' with high, low, and middle scenarios.

The scenarios are:

- **Level 1 Low/Limited: "Best Efforts"**: CNCP funding continues, internally funded optimization and small renewal efforts continue. Major capital programs are focused on non-energy related building components and only allow for a minor level envelope of funding for replacing or upgrading mechanical systems.

- **Level 2 Medium: "Getting Serious"**: Funding is more available for energy systems than Level 1 and resulting carbon reductions are better. Most projects can devote some capital to reducing carbon emissions – though complete renewal as a zero-carbon facility is problematic. As a result, some projects can transition to low carbon heating and cooling systems.

- **Level 3 High: "Full On"**: All funding programs continue and achieve high impact results. Capital funding is sufficient to allow for major replacement and retrofits of heating and mechanical systems with all SMP projects. SMP program moves steadily.

The results of this analysis are shown in Table 5 and the carbon reduction shown in Figure 5. For this presentation, the totals are shown to 2035 to capture all the identified projects on the capital plan to completion – as some would initiate several years before their impact would be realized.

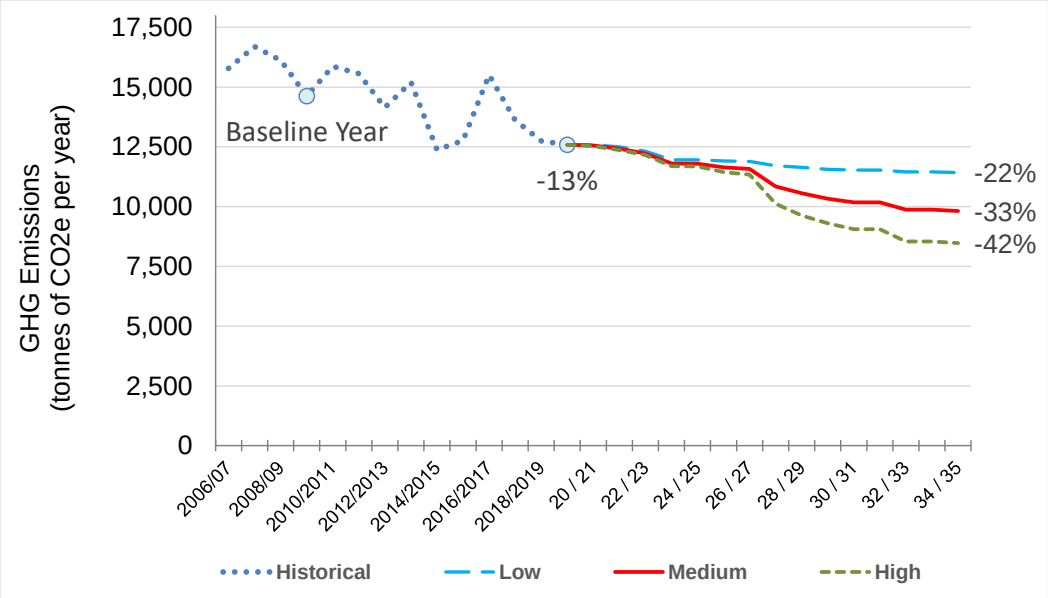
The carbon emissions scenarios are shown graphically in Figure 5. The current building GHG emissions for the District are about 13% below the baseline year level (2010). The consumption of natural gas (the primary driver of GHG emissions) is affected by the weather. The variability seen in the historical GHG emissions from 2006/07 to the present is primarily a function of the weather. There have been several natural gas conservation measures taken over the past 15 years, but these account for only a portion of the 13% decrease. Going forward, a more concerted effort towards natural gas reduction will become apparent as a more definite reduction – regardless of background weather conditions.

Table 5: Energy and Carbon Reduction Scenarios at 2035

Item	Units	1) Low	2) Med	3) High
NG / GHG Baseline (2010)				
2010 Natural Gas Consumption	GJ / yr	298,310	298,310	298,310
Baseline Building Carbon Emissions	tonnes CO2/yr	15,160	15,160	15,160
NG / Carbon Impacts to 2035				
NG Consumption Change…	GJ/yr	(65,000)	(98,000)	(125,000)
Carbon reduction (tonnes)	tonnes / yr	(3,200)	(4,800)	(6,100)
…compared to baseline levels	(%)	- 22 %	-33 %	-42 %
Electricity Impacts				
Current Electricity Consumption (19/20)	kWh/yr	24,570,000	24,570,000	24,570,000
Elec consumption at 2035	kWh/yr	27,100,000	28,900,000	30,200,000
Consumption change	kWh/yr	2,500,000	4,300,000	5,600,000
Utility Cost Impacts (Annual)				
Natural Gas Spending Change	$ / yr	(651,000)	(980,000)	(1,254,000)
Electricity Spending Change	$ / yr	250,000	429,000	565,000
Carbon Offset Change	$ / yr	(84,000)	(126,000)	(160,000)
Vancouver Carbon Levy	$ / yr	1,615,000	1,178,000	1,051,000
NET utility Spending Change	$ / yr	1,130,000	501,000	202,000
Capital Requirements				
Total Capital Req'd from 2020 – 2035	$	26,000,000	51,000,000	98,000,000

Notes:
1) Values are planning level estimates only and do not include site-level costing.
2) All costs and savings are shown in 2021 dollars. No discounting of future cash flows nor forecasting of cost escalation for different components has been attempted.

Figure 5: VSB Building -Related Carbon Emissions by Scenario



Note: Reductions shown are based on assumptions about the capital resources being available. No capital has been currently secured beyond current year programs and approved seismic projects.

Funding Sources:

Achieving the reductions shown by any of the scenarios shown in Figure 5 is highly dependent on the level of capital funding the District can deploy. None of the current capital funding programs are confirmed beyond each year's allocation. The possible sources of capital funding programs includes:

- **Annual Facilities Grant (AFG):** The District receives approximately $10 million annually through the Provincial AFG allocation. This amount has remained essentially unchanged over the past few years. As a result of normal cost inflation, the AFG allotment purchases about 1/3 less than a decade ago. This funding is generally completely consumed for high priority or life safety systems. Limited to no funds are available for deferable projects.

- **School Enhancement Program (SEP):** The SEP funding program is suitable for similar projects to AFG funding. For the past few years, SEP funding requests have been used to fund components of the SMP that are not funded through that initiative.

- **Carbon Neutral Capital Program (CNCP):** The CNCP program funds carbon reducing initiatives – typically heat plant replacement projects. This program has funded most heat plant re-builds and control system upgrades over the past several years. Funds are not assured from this program.

- **Utility Incentives:** The energy utility companies provide incentives and rebates for energy conservation projects. This is a relatively small amount of funding and is typically used to fund energy audits and studies as well as the building optimization initiatives.

- **Seismic Mitigation Program (SMP):** The SMP is the '*elephant in the room'* for capital funding in the District as it is by far the largest of the funding opportunities – easily an order of magnitude greater than any of the other programs. Some SMP projects have been able to fund new school builds and while all of these have created more efficient schools, they have not all been able to properly resource low carbon systems. The future of this program appears to be leading to more seismic upgrades rather than new school builds and so the SMP cannot be relied upon to appropriately fund carbon reduction activities.

- **Emerging Low Carbon Funding**: Provincial and Federal programs have been announced or launched to encourage low carbon buildings. At present these initiatives are in the category of 'incentives' – whereby the program provides a few percent of the capital cost to incentivize an outcome. o date, none of these programs provides substantive grant funding. There are also emerging sources of financing funds proposed but these are not grant capital and require a return on investment to eligible – they are loan and not grant programs. The return on

low carbon investments in the District does not generate an investment competitive return on capital invested.

This analysis has identified the capital requirements to make substantive carbon reductions. However, all capital funding is year to year or project by project.

Staff Roles and Responsibilities

Implementation of the SEMP will require the involvement of several different teams within the organization. These are summarized in Table 6. It is important to note that there are many participants and that coordination and communication between groups is required to ensure smooth implementation.

Table 6: Implementation Activities and Participants

Activity	**Lead**	**Participants** (in addition to the Energy Manager)
Project List Review and Update	Energy Manager	▪ Operations ▪ Maintenance ▪ Seismic Project Office
Annual Project Planning	Energy Manager	▪ Operations ▪ Maintenance
Incentive & Funding Applications (e.g., Fortis, BC Hydro, CNCP)	Energy Manager	▪ Maintenance
Capital Plan Preparation	Facilities Director	▪ Operations ▪ Maintenance
Lighting Project Implementation	Maintenance (Electrical)	▪ Maintenance
Heating & DHW System Upgrades	Maintenance (Mechanical)	▪ Operations
Operational Improvements	Energy Manager	▪ Operations ▪ Maintenance
New Facility Criterion	Energy Manager	▪ Facilities Planning
Annual Reporting	Energy Manager	▪ Operations ▪ Maintenance

Reporting

Tracking and progress reporting happens through several internal and external mechanisms including:

- **BC Hydro Quarterly Meetings:** The EM program is a contractual relationship with BC Hydro. Annual conservation targets are set and are reviewed through quarterly progress meetings.

- **Internal Reporting:** The Energy Manager reports to the organization through the Facilities Director and Secretary Treasurer. Routine briefing and internal reporting occur within the organization.

- **Board and Facilities Planning Standing Committee:** Facilities related issues are accountable to the Board through the Facilities Planning Committee – one of the five standing committees of the Board. From the committee, reports are carried to the Board level.

6 The VSB Energy Plan and the Vancouver Climate Emergency Strategy

In January 2019, Vancouver Council declared a climate emergency in recognition of the urgent threat posed by climate change, and as a call to scale up Vancouver's efforts to cut carbon pollution. In April 2019, Council approved the Climate Emergency Response – a high level policy statement, which established six key areas of activity (referred to as "Big Moves") to guide the City's efforts in response to the climate emergency. These are titled:

- Walkable, complete neighbourhoods
- Active Transportation and Transit
- Zero emissions vehicles
- Zero emissions space and water heating
- Low-carbon materials and construction practices
- Restored coasts and forest.

The policy statement included timelines and targets for reaching them and built upon numerous previous City plans and resolutions.

The Climate Emergency policy also identified 53 accelerated actions that the city could deploy to initiate change swiftly. A brief summary of these is provided below. A scan of the action descriptions indicates that of the 53 accelerated actions, 17 lend themselves to the VSB being a participant or contributor, 12 are future possibilities, and 24 are not generally applicable to the VSB to implement as they are city operations or exclusively under municipal authority. The actions where the VSB could be a participant are generally consistent with the actions in the VSB Environmental Sustainability Plan.

In November 2020, City council approved a "Climate Emergency Action Plan (CEAP)" which provided a pathway for implementing the policy of Big Moves 2 through 5. The CEAP provided detail of future policy and regulatory requirements – including implementation actions. The CEAP identified a number of subsequent bylaws and regulations that would be required to implement the plan and indicated approximate timelines for their development of these regulatory tools. The CEAP advanced several of the actions from a firm deadline of the initial policy statement, into a transitional action plan that combines regulatory action as well as incentive & penalty regulations to incentivize a transition to lower emissions.

In many areas the city's CEAP has incorporated some of the accelerated actions. The current plan document is structured around the six Big Moves and does not highlight the accelerated actions as a package of measures.

Finding solutions to the issues of climate change will require participation from all components of society. For just the starting goal of simply finding a path to reduce emissions, numerous government, agencies, industry sectors will all have to contribute. There will be many opportunities to interact, collaborate, partner, and add value to the other's activities. A simple Venn diagram of just a few of the technological players indicates the complexity. Overlay numerous players involved in economic development, social welfare, governance and so forth and the complexity increases dramatically.

A "Simple" Schematic of the Technical Players involved in Reducing Carbon Emissions

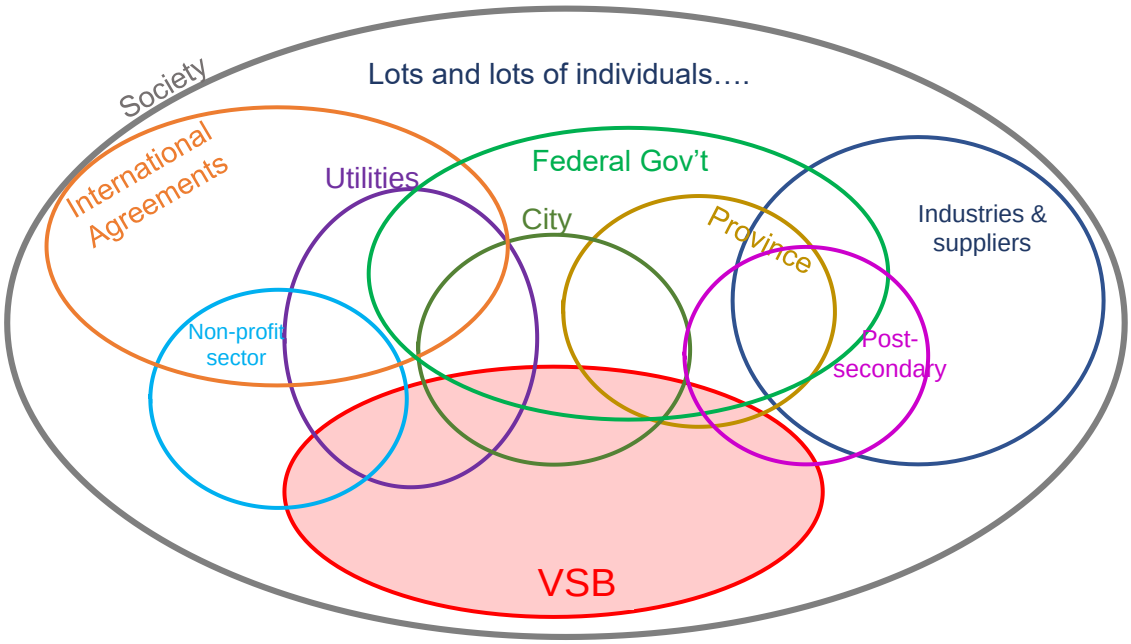


Table 7: City of Vancouver Climate Emergency Response Connections to the VSB SEMP (as of fall 2021)

Area	Action #	Action Title	Relevance to the VSB	Comments / Examples
City-wide Planning	1	a. Sustainable Mode Splits	Participant	Active Travel Planning Initiative (2012-present) School Streets Pilot (2021)
	2	b. Infill Pilot Program	n/a	
	3	c. Small Townhouse Pilot Program	n/a	
	4	d. Barriers to Low Embodied Carbon	Participant	Lessons learned from two CLT Wood construction schools (Begbie, DLG) can provide case study insight.
	5	e. City-wide and Area-Specific Plans	Participant	
	6	f. Expanded Goals for Design Guidelines	Participant	VSB and CoV working together on low emissions roof top child care as well as Passive House multiuse facility (Coal Harbour)
Zero Emissions Areas	7	a. Zero Emissions Areas	Future Possibility	Action is not defined in sufficient detail
Land Use Incentives for Green Buildings	8	a. Time-limited pre-regulatory Density Bonus incentives for Zero Emission buildings	Future Possibility	VSB not able to access at present
	9	b. Deep Emissions Retrofits	Future Possibility	Focus is on land use planning
	10	c. Improved Floor Space Incentives for Zero Emissions:	Future Possibility	VSB not able to access at present
Financial Incentives for Zero Emissions Buildings and Equipment	11	a. Financial Incentives for Existing Building Energy Retrofits	Future Possibility	Fund not established at present
	12	b. Climate Trust	Future Possibility	Fund not established at present
	13	c. Heat Pump Permits	n/a	Not applicable to VSB
Zero Emissions Building Standards	14	a. New Zero Emissions Buildings	Participant	
	15	b. Improved Compliance	Participant	
Neighborhood Energy	16	a. Renewable Energy Supply	n/a	City facility
	17	b. Expand Service Area	n/a	City facility
Active Transportation and Transit Infrastructure	18	a. Improved Bus Service	Participant	Consultation and input on routing, but no direct role
	19	b. Active Transportation Network	Participant	Ongoing planning and pilot project participation
	20	c. E-Bike Share	Future Possibility	Status unknown
Transportation Demand Management	21	a. City-wide Transportation Demand Management Program	Participant	Active Travel Planning Initiative (2012-present)
	22	b. Support for electric bikes	Future Possibility	Status unknown
	23	c. Transportation Pricing	n/a	City Authority
	24	d. Parking Requirements	n/a	City Authority
	25	e. On-Street Car Share Parking	n/a	City Authority

Area	Action #	Action Title	Relevance to the VSB	Comments / Examples
Goods Movement and Fleets	26	a. Urban Freight and Fleets	n/a	City Authority
	27	b. Curbside Zone Management	n/a	Relates to commercial loading zones. Not relevant to schools
Electric Charging Network	28	a. Neighbourhood Charging	Participant	Provide charging infrastructure at some sites - typically pay parking sites. Development of a cost recovery framework will enable broader deployment.
	29	b. Film, Food Trucks and Special Events	n/a	Cost prohibitive. Industry is evolving rapidly and are likely to address the issue independently.
	30	c. Commercial Buildings	Participant	
	31	d. Fast-Charging Network	Future Possibility	Cost Prohibitive. Current Level2 infrastructure.
	32	e. Home Charging in Rental Buildings	n/a	Not relevant to VSB
	33	f. Electric Tour Buses	n/a	Not relevant to VSB
Electric Vehicle Incentives	34	a. Parking for Zero Emissions Car-Share Vehicles	Future Possibility	Not deployed at present
	35	b. Car Share Parking Rates	Future Possibility	Not deployed at present
Solid Waste	36	a. Reducing Wasted Food	n/a	Commercial Sector
	37	b. Renewable Gas Supply	n/a	Relates to Vancouver landfill. However VSB could explore Fortis renewable natural gas opportunities as supply increases.
	38	c. Construction and Demolition Waste	n/a	Relates to Vancouver landfill
	39	d. Recycled asphalt and aggregate	n/a	VSB does not have an asphalt plant
Food and Beverage	40	a. Restaurants and Breweries	n/a	Commercial Sector
	41	b. Diets that are Healthy for People and the Planet	Participant	Food and garden educational programs at numerous schools.
City Leadership	42	a. Facilities Capital Maintenance	Participant	VSB and CoV working together on low emissions roof top child care
	43	b. Embodied Carbon	Participant	Pilot study with co-development projects with the City
	44	c. City Fleet	n/a	Relates to the City fleet.
	45	d. Fleet Charging	n/a	Relates to the City fleet.
	46	e. Manitoba Works Yard Energy Hub	n/a	City facility
	47	f. Small Equipment	Participant	VSB has initiated a pilot test of electric landscaping initiatives.
	48	g. Sustainable Commuting	n/a	Relates to CoV employees.
	49	h. Online Services	n/a	Relates to CoV service delivery
	50	i. Support for Cities in Developing Countries	Future Possibility	Status unknown
Inter-Governmental Relations and Community Engagement	51	a. Intergovernmental Relations	n/a	
	52	b. Community Engagement	Participant	Have been working with non-profit sector and UBC researchers on educational initiatives for several years.
	53	c. Partner Engagement	Participant	Status unknown

7 Closing

This energy strategy has identified a multi-year project list for electricity conservation, natural gas reduction, and greenhouse gas emissions reduction. This is in accordance with the requirements for funding through the BC Hydro Energy Management Program – achieving approximately 300,000 kWh annually of electricity savings.

Additionally, substantial opportunities to reduce natural gas consumption – and associated carbon emissions are identified.

This strategy recognizes the need for action on climate change to reduce the District's carbon emissions. The Province has mandated that public sector organizations in BC reduce their building-related carbon emissions dramatically from 2010 levels – heading towards net-zero-carbon by 2050.

Currently, the District's emissions are about 13% below baseline (2010) levels – partially due to weather factors, and partially due to conservation efforts.

To support the conservation objective, this plan identified scenarios for reducing carbon emissions from District facilities. A set of "low-medium-high" scenarios identified that reductions of 22% to 42% from baseline are possible by 2035. These reductions require substantial capital investment – ranging from $ 26 million to $ 98 million. Post-2035 opportunities for further reductions can still be made – though several tens of millions of capital dollars will still be required.

Appendix A: Future Project Opportunities

The table below presents a rolling three-year list of projects that are either recently completed (2021), underway (2022 projects) or being developed and planned (2023 projects and onward).

Table A-1: Lighting Retrofit Opportunities

Action	Year	Project Opportunities	Savings
Action 1: **Lighting Upgrades**	**2022** underway 2022 AFG budget	Prince of Wales Sec Point Grey Sec Bruce Elementary Gladstone Sec	550,000
	2023 Audits to be conducted late 2022 Project funding beginning with 2023 AFG year	Queen Alexandra Oppenheimer Tecumseh Ax Southlands Xpey' Tyee	To be determined. Savings estimated as 175,000
	2024 and beyond Project funding beginning with 2023 AFG year	To be determined	To be determined.
Action	Year	Project Opportunities	Savings
Action 2: **Heating Plant Upgrades**	**2022** Completed	Norquay	~2,500 GJ
	2023 -2030 School sites with aging atmospheric boilers	Magee University Hill Elementary Kerrisdale Laurier Tecumseh	~5,000 - ~15,000 GJ
	2030 and beyond	Possible Annex Site Opportunities	~5,000 - ~10,000 GJ
Action	Year	Project Opportunities	Savings
Action 3: **Building Systems Upgrades**	**2022** (underway)	Planning: Compile an inventory and priority listing for Unit Ventilator upgrades and replacement	--
	2023	Ventilation Refurbishment and upgrades	tbd
	2024 and beyond	tbd	Tbd

Action	Year	Project Opportunities	Savings
Action 4: **Building Optimization**	**2022** (completed)	Magee	54,000 kWh 1,230 GJ
	2023 **(underway)**	Kitsilano	~75,000 kWh ~2,000 GJ
	2024 and beyond	Churchill Sec Dickens Douglas Norma Rose Point Trafalgar Sexsmith Kitchener Queen Mary	300,000 to 700,000 kWh 5,000–10,000 GJ
Action	Year	Project Opportunities	Savings
Action 5: **Low-Carbon features in the Seismic Mitigation Program**	**2022** (underway through SMP)	Heat Pump Installation at: Bayview VRF system in childcare at: David Lloyd George	1,000 GJ tbd
	2023	Heat Pump at Hudson Elementary Heart Pumps at Coal Harbour Elementary (non-seismic project)	1,000 GJ tbd
	2024 and beyond	Upcoming Seismic Project Opportunities Two elementary and two secondary projects identified in the capital plan.	tbd
	Capital Planning Submission: **2025-2030**	Seismic Capital Plan Opportunities <u>Elementary</u>: Potentially 12 - 14 sites as identified in the capital plan submission. <u>Secondary</u> Potentially up to 5 sites as identified in the capital plan submission	tbd
	2030 and beyond "Distant" Opportunities [Projects will be dependent upon the scope of the seismic program beyond the projects identified in the current five-year capital planning horizon]	<u>tbd</u>	tbd

Note: electricity savings are as kWh, natural gas savings are shown as GJ

Appendix B: Scenario Methodology

For each type of action an archetype level of savings and expenditure was developed. This is based on a number of recent projects implement over the past decade within the district.

Table B-1: Scenario Methodology and Assumptions by Project Type

Activity	Level 1: Low	Level 2: Med	Level 3: High
Boiler Replacement	Typically replace boilers in mechanical room with high efficiency wall mount (low mass) boilers. Remainder of school unchanged. Savings: -NG = ~30% -Electricity = ~2% Cap cost = ~$350,000 each	Level 1 *plus*: - replace hot water heater with on-demand system and - incorporate variable speed pumping units to control flow to zones within the school: Savings: -NG = ~40% -Electricity = ~4% Cap cost = ~$425,000 each	Level 2 *plus*: - incorporate room temperature and/or CO2 sensors to improve demand controlled ventilation and hot water reset strategies. Savings: -NG = ~50% -Electricity = ~6% Cap cost = ~$500,000 each
Continuous Optimization (C.Op.)	Recommission existing site with existing DDC controls and sensor set-up. Replace occasional sensor failure. Savings: -NG = ~5 % -Electricity = ~5% Cost = ~$50,000	Level 1 *plus*: - add in additional sensors temp or CO2 and enable HWReset and DCV Savings: -NG = ~10% -Electricity = ~10% Cap cost = ~$100,000	Level 2 *plus*: - digitize the entire site – including DDC controls and replacement of pneumatic systems. Savings: -NG = ~10% -Electricity = ~15% Cap cost: ~$ 150,000 (elem) ~$ 450,000 (secondary)
Mech Upgrade	Minor upgrades to systems and mechanical alignment. (e.g.Re-piping or reconfiguring mech room). Savings: -NG = ~5 % -Electricity = ~5% Cost = ~$100,000	Mech upgrade or replacement of AHUs or a number of Unit Ventilators. Savings: -NG = ~10% -Electricity = ~10% Cap Cost: ~$500,000 (elem) ~ $2,500,000 (sec)	Major re-piping or steam to HW conversion of an entire site Savings: -NG = ~30% -Electricity = ~15% Cap cost: ~$ 1,500,000 (elem) ~$ 5 - $ 10 million (sec)
Seismic Project through the VPO	Seismic Upgrade that does not specifically replace mechanical systems but might include some minor components and lighting upgrades Savings: -NG = ~10 % -Electricity = ~15% Cost ~$ 150,000 (elem) ~$ 1,000,000 (secondary)	Major seismic rebuild or new site without low carbon technology Savings: -NG = ~45% -Electricity = ~+20% (incr) Cap cost: ~$ 600,000 (elem) ~$ 3,500,000 (sec)	Complete re-build including HVAC or new site with HP or other low carbon heating system. Savings: -NG = ~75% -Electricity = ~50% (incr) Cap cost: ~$ 1,000,000 (elem) ~$ 7,500,000 (secondary)

Appendix C: Past Energy Conservation Projects

Table C-1: Historical Energy Management Actions: 2013/14 to 2020/21

Site(s)	Study	Project Status *[Year project was executed and claimed or completed]*	Savings *[kWh /yr unless otherwise noted]*
Projects 2013/14			
RobertAx / Byng / Shaughnessy / McBride	Lighting study 2011/12 – 2012/13	2014	146,000
TechumAx / Mount Pleasant / Oppenheimer / MaquinnaAx	Lighting study 2011/12 – 2012/13	2014	176,000
Tupper B Building	Lighting study 2012/13	2014	62,700
Van Tech	Lighting study 2012/13	2014	101,000
Macdonald	Lighting study 2012/13	2014	56,500
Tyee / Selkirk / Laurier	Lighting study 2012/13	2014	74,000
Sexsmith	Energy efficient lighting design (EELD)	2014	34,000
Douglas	Energy efficient lighting design (EELD)	2014	28,000
Projects 2014/15			
Moberly	Lighting study 2013/14	2015	51,000
Carnarvon	Lighting study 2013/14	2015	52,400
Champlain Heights	Lighting study 2013/14	2015	54.000
Queen ElizabethAx / Total Education	Lighting study 2013/14	2015	50,000
Champlain HeightsAx	Lighting study 2013/14	2015	58,000
LaurierAx / GaribaldiAx	Lighting study 2013/14	2015	43,000
U-Hill Secondary	Energy efficient lighting design (EELD)	2015	31,000
Norma Rose	Whole Building Design	2015	158,000
Fraser	Boiler Plant upgrade	2015	~95 GJ /yr
Tyee	Boiler Plant upgrade	2015	~42 GJ / yr
Moberly	Boiler Plant upgrade	2015	~400 GJ / yr
Projects 2015/16			
DougAx / Kerr Gym / McKechnie Gym	Lighting study 2014/15	2016	55,000
Lord A & B Buildings	Lighting study 2013/14	2016	56,000
Workshop	Lighting study 2013/14	2016	47,000
Magee	Lighting study 2014/15	2016	186,000
Britannia	Lighting study 2014/15	2016	187,000
Projects 2016/17			
Ed Center	Lighting study 2014/15	2017	228,000
Queen VictoriaAx / South Hill / Byng (ext) / VanTech)	Lighting study 2014/15	2017	90,000
Queen Mary	Energy efficient lighting design (EELD)	2017	42,500
Kerrisdale / Hastings (ext) / Dickens(ext)	Lighting study 2015/16	2017	52,463
McKechnie / DickensAx / Collingwood(ext) / Cook(ext)	Lighting study 2015/16	2017	57,176
Elsie Roy / Maquinna / Collingwood(int)	Lighting study 2015/16	2017	109,534
L'Ecole Seismic replacement	Replacement school	2017	~ 400 GJ
Gordon Seismic Replacement	Replacement School	2017	~ 1,260 GJ
Cook (int) / Hastings(int) / Cunnigham(ext)	Lighting study 2015/16	2017	75,796
Projects 2017/18			
Cunningham (int) / Tillicum Ax	Lighting study 2016/17	PE File 2018	76,073
Crosstown	Energy efficient lighting design (EELD)	2018	32,750
McBride	Boiler Plant	2018	~500 GJ
McBride	Lighting study 2016/17	PE File 2018	~74,801
Strathcona	HVAC and Boiler upgrades	2018	~ 1000 GJ

Site(s)	**Study**	**Project Status** *[Year project was executed and claimed or completed]*	**Savings** *[kWh /yr unless otherwise noted]*
Strathcona	Lighting study 2017/18	study underway	tbd
Roberts / Shaughnessy / Fraser / Ideal Mini	Lighting study 2016/17	2018	~133,800
Tecumseh / Norquay	Lighting study 2016/17	2018	~96,600
U-Hill Elementary	Lighting study 2016/17	2018	~50,325
Van Horne / Nootka	Lighting study 2016/17	2018	~64,300
Carr	Lighting study 2016/17	PE File 2018	~41,300
Kitsilano	Whole Building Design	NCP/2018	~760,000
Projects 2018/19			
Churchill	Lighting	2019	~150,000
Henderson / Grandview	Lighting	2019	~76,000
Beaconsfield / Kerrisdale Anx	Lighting	2019	~50,000
Brock / MacCorkindale	Lighting	2019	~80,000
Projects 2019/20			
Queen Elizabeth, Quesnel, Trafalgar	Lighting	2020	115,000
Seymour, Thunderbird	Lighting	2020	85,000
Nightingale, Secord	Lighting	2020	72,000
McBride Ax, Selkirk Ax, Trudeau	Lighting	2020	61,000
Killarney Gym	Lighting	2020	22,848
Quilchena, Osler, Jamieson	Lighting	2020	111,000
Van Tech	Continuous Optimization	Complete 2020	50,000 kWh
U-Hill Sec	Continuous Optimization	Complete 2020	100,000 kWh
Projects 2020/21			
Tupper	Lighting	2021	63,000
Van Tech	Lighting	2021	117,500
Mount Pleasant & Franklin	Lighting	2021	58,500
Seymour (frame bldg.)	Lighting	2021	5,000
Dickens (Gym)	Lighting	2021	5,443
Hastings	Boiler Plant	2021	~ 1,000 GJ [note 1]
Selkirk	Boiler Plant	2021	~1,000 GJ [note 1]
Maple Grove (new)	Heat Pump Installation	2021	--

Notes:

1) *Natural gas savings for recent upgrade projects is estimated and observed changes will have been affected by COVID-19 closures and operational changes. Accurate savings evaluations will require further years of monitoring.*

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